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THE POTOMAC ESTUARY STATISTICS AND PROJECTIONS

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Federal Water Pollution Control Administration
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* Presented at the winter public meeting of the Interstate Commission on the Potomac River Basin at Fredericksburg, Virginia, on February 29, 1968

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Before examining the Potomac Estuary in particular as a changing environment, it is necessary that we view the critical area of the upper estuary, the center of our interest in this discussion of water quality, in its proper perspective within the entire Potomac River Basin. Since problems of the Potomac Estuary were last discussed at a meeting of this group in 1964, considerable data have been collected and analyzed which enable us to identify more precisely areas where water quality degradation has occurred, the extent to which inadequately treated waste discharges continue to contribute to this degradation, and the effect of desirable and necessary corrective actions by municipalities or industries.

Several stream segments upstream from the Metropolitan Washington area have been identified where water quality does not conform with established nor proposed State standards. However, in every case the natural assimilative capacity of the receiving waters has been adequate to eliminate any measurable

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water quality degradation long before it reached the upper estuary near Washington. Staff of the Chesapeake Field Station of the Middle Atlantic Region, Federal Water Pollution Control Administration, have determined the general pollution abatement actions necessary to control the major waste discharges of the Potomac River Basin. These immediate needs have been presented in an internal document made available to pertinent State, County, and other governmental agencies as a cooperative service, in accordance with the Federal Water Pollution Control Act of 1965. We have also carried out special studies of the upper estuary and of selected upstream reaches of the River, as requested by the Water Quality Sub-Task Group of the President's Interdepartmental Task Force on Project Potomac. Several technical data reports have been published in connection with bacteriological, nutrient, diffusion, and other investigations of water quality conditions in the Potomac Estuary.

It should come as no surprise to you that more than two-thirds of the total pollution load in the Potomac River Basin, expressed as 5-day biochemical oxygen demand (BOD), is discharged as treated sewage wastes into the upper Potomac Estuary. Fortunately, industrial development envisioned by President George Washington has not materialized, so that industrial wastes are not a significant part of the water quality problem in the Estuary today.

The waste assimilative capacity of the free-flowing River upstream is greater than that of the Estuary where the net seaward flow is slow, especially during the critical low flow months in late summer. Waste loads from the Washington Metropolitan area's population of approximately two million people, after present treatment levels, are equivalent to the untreated sewage from 850,000 people. This load of approximately 140,000 pounds of 5-day BOD per day is eight times the assimilative capacity required to maintain a dissolved oxygen (DO) average of 5 milligrams per liter (mg/l). We find that the proposed DO objective has not been met in recent years between Fort Washington and the Alexandria-Washington area, and that the DO at certain critical low flow periods has approached total depletion. The high BOD loads are the major but not the only causes of the oxygen depletion observed. Bottom deposits, representing accumulated suspended organic solids discharged from sewage treatment plants exert appreciable oxygen demand upon the estuarine waters. Also, the nutrient content of these discharges may stimulate profuse algal blooms which, while objectionable in themselves, also deplete DO upon decay. These are among the several factors contributing to water quality degradation observed in the Estuary.

There has been no clearly defined downward trend in DO values in the upper Estuary since 1964, even with the unusually low flows during the summer months of the intervening years. This may reflect some improved treatment plant efficiencies.

Bacterial pollution is excessive in the Metropolitan area by any standards. There has been a general upward trend in the mean coliform counts since 1964. Average counts observed have been as high as 500,000 MPN per 100 ml in sections of the upper Estuary. Counts in excess of 1,000 per 100 ml generally classify water unsuitable for recreational use. The upward coliform trend can be attributed to the increase in population served by sewage treatment plants which chlorinate effluents during the summer months only and by increase in urban runoff during storms.

Intensive bacteriological investigations by staff of the Chesapeake Field Station, conducted from January to March 1967, showed highest coliform counts at the Woodrow Wilson Bridge sampling station but decreasing somewhat toward Fort Washington. Considerably lower counts were recorded at stations both upstream and downstream from these bounds. There is a net downstream movement in the Estuary accounting for a part of the gradual coliform decrease by dispersion and dilution. Normal tidal excursion, however, tends to retain high counts in the general area of the major sewage treatment plant discharges and may explain some of the erratic high counts found at upstream stations near the head of the Estuary. Median counts per 100 ml at Woodrow Wilson Bridge for this period were 91,000 MPN coliforms and 25,000 MPN fecal coliforms (E. Coli). Incidentally, positive salmonella was identified in seven out of nine swabs taken. Note that the approved Maryland water quality standards for this reach specify

that a count in excess of 240 MPN fecal coliforms per 100 ml indicates a need for a supplementary sanitary survey. By bacterial standards, it is obvious that the estuarine waters are grossly polluted.

Other water quality parameters have not changed significantly since 1964. Staff of the Chesapeake Field Station have conducted rather intensive surveys as the basis for planning effective pollution control action programs for the upper Potomac Estuary. Primary sources of pollution are the six major municipal waste treatment plants in the Washington Metropolitan area. These plants are discussed below in order of total waste load contribution. The approximate population equivalent discharged by each plant is shown in Figure 1. It must be borne in mind that in working with biological processes, the sampling data vary widely; nevertheless, a mean of continuous sampling data over the year will furnish a reliable index of plant performance.

The District of Columbia Water Pollution Control Plant discharges approximately 72 per cent of the total BOD load to the Estuary. Although the plant efficiency has increased from approximately 60 to 70 per cent BOD removal, this falls short of the 85 per cent removal that can be expected reasonably from secondary treatment plants. The load, however, has increased some 25 per cent since 1964, so that there has been no significant change in the net BOD load discharged to the Estuary. Additional primary facilities are presently being designed.

The Arlington Sewage Treatment Plant accounts for 16 per cent of the total load to the Estuary. This loading is a disproportionate share according to the population served, but the sewage receives only primary treatment which amounts to approximately 35 per cent BOD removal. Secondary treatment facilities have been completed and are currently under test, with full operation anticipated in March of this year. These facilities are designed for 90 per cent BOD removal.

The Fairfax County Westgate Sewage Treatment Plant contributes seven per cent of the total loading to the Estuary from an intermediate type treatment plant with approximately 50 per cent BOD removal.

The City of Alexandria Sewage Treatment Plant discharge represents four per cent of the total BOD load. The plant provides secondary treatment with approximately 75 per cent BOD removal efficiency. There is a temporary overloading of these facilities from Fairfax County sewers which have been accepted pending construction of additional facilities by Fairfax County in Accotink.

The remaining sewage treatment plants in the area are Fairfax County's Dogue Creek and Little Hunting Creek plants and the Department of Defense Ft. Belvoir and Pentagon plants. All of these plants contribute approximately one per cent of loading to the Estuary. Relatively remote locations have little adverse effect on water quality.

In correlating average monthly DO values along the upper Estuary with location of treatment plant outfalls, it can be seen that the values decrease steadily to a minimum for the two miles upstream from Woodrow Wilson Bridge. This area receives the discharge from the District of Columbia, Arlington, Alexandria, and Fairfax-Westgate Sewage Treatment Plants (Figure 1). There is a slow recovery from this area to Fort Washington where a DO value of 4 mg/l is reached.

Summarizing, it can be stated that water quality in the upper estuarine zone in the Metropolitan Washington area is degraded as indicated by the DO and bacterial parameters. An analysis of the historical data since 1964 shows no significant quality change, either degradation or improvement. The effects of impounded efficiency in the sewage treatment plants and some limited reduction in the frequency and intensity of combined sewer overflows appear to have been offset by an increase in waste loads from the rapidly expanding population. As a basis for evaluating the waste assimilative capacity of the upper Estuary, Maryland water quality standards for DO have been applied; since a major part of the critically polluted areas are located in Maryland waters, as can be seen from the map (Figure 2). Standards for the State of Virginia and the District of Columbia have been submitted, though not yet approved. These standards are expected, however, to be compatible with those of Maryland for adjoining segments and for principal tributaries flowing into the Potomac River.

The water quality data collected by the District, the States, and other agencies have been supplemented with sampling and analyses by staff of the Chesapeake Field Station. The annual compilations of water quality data from the cooperative network of the Interstate Commission on the Potomac River Basin have been especially useful.

Water quality and associated waste load data have been used as input to the Potomac River mathematical model. This model represents a systems analysis approach which enables us to examine and predict water quality problems that may occur and to develop alternative solutions which may be made available to basin-implementing agencies. A discussion of the Potomac Estuary model, developed by Dr. Leo J. Hetling, formerly of the Field Station, was presented at a previous meeting. This model is of special interest as it has been applied in the solution of DO, nutrient, and salinity problems. Based upon an analysis of flows during the critically dry years of 1964, 1965, and 1966, it has been determined that area sewage treatment plants will be required to remove the following percentages of 5-day BOD to achieve the corresponding mean DO levels in 1985:

Per Cent BOD Removal	Mean DO in mg/l
80	1.5
85	3.0
90	4.0
95	5.0

The above figures were based upon utilization of Bloomington and Savage Reservoirs and water use as projected by the Corps of Engineers in their Potomac River Basin Report, and they include the effects of benthal uptake. In general, the indicated minimum DO figures run about 1 mg/l below the mean.

For comparison, the 1965 DO profile shows a mean of 2 mg/l with a minimum less than 1 mg/l. If 85 per cent BOD removal were assumed, the mean DO projected for the critical months of July, August, and September would be somewhat below 5 mg/l and the minimum, slightly below 4 mg/l. This level of treatment can be reasonably achieved by conventional biological methods and is used as a basis for the short-term projections that follow.

The staff of the Chesapeake Field Station is actively engaged in development of a comprehensive program for reducing pollution in the Potomac River Basin. This involves the collection and analysis of data from water quality investigations, the identification of waste discharge sources, technical assistance to other agencies, the development of new systems analysis techniques for evaluating effects of present and future waste discharges on water quality, and the determination of immediate needs for pollution abatement.

Comprehensive water pollution control programs for other basins of the Chesapeake Bay Drainage Area are also under way in cooperation with interstate, State, and local agencies and other interested organizations.

A mathematical model of the free-flowing upstream Potomac River has also been developed and verified for main stem segments only at this time. Further work is in progress to refine the model for several tributaries which have local water quality problems. This model will permit rapid evaluation of effects of projected waste discharges on water quality at virtually all critical locations in the Potomac River Basin. It is necessary for the Chesapeake Field Station staff to possess interdisciplinary technical competence since chemical, bacteriological, biological, oceanographic, and mathematical as well as the engineering disciplines are represented. The Field Station is also investigating biological aspects of thermal pollution, nutrient-chlorophyll relationships, and small boat pollution effects.

In attempting to make projections, better qualified prognosticators have hesitated where water pollution abatement was involved, and the usual course is to refer the complexity of the problem and propose further studies. However, it should be obvious from the items presented thus far that first, the Potomac estuarine water quality is degraded far beyond any reasonably accepted standards; and second, the direct cause, the inadequately treated sewage disposal plant wastes, requires correction. The agencies responsible for each treatment plant are aware of each plant's deficiencies in capacity and efficiency. A program to provide this capacity and the minimum 85 per cent removal by conventional biological treatment can be realized. All that is

necessary is the appropriation of funds for the design, construction, and operation of the additional facilities. At the same time, some provision for advanced waste treatment should be included. In addition, full-time chlorination at all sewage treatment plants is essential for control of bacterial pollution.

Sewer separation programs will continue, and new approaches to reducing overflows and urban runoff will be explored under present research grants. Turbidity in the River will be reduced by enforcement of existing regulations and enactment of new regulations similar to those pioneered in Montgomery County.

The program just outlined can be placed into effect within three years and should be implemented immediately as a first step. An interstate agency to resolve political differences and prepare the long-term plan must be established.

The technical expertise is available. Water quality enhancement can be realized, but it is contingent upon aroused citizen interest to demand action and assume the financial obligations that such action entails.

In short, pollution abatement in the Potomac River Estuary is up to you!

POTOMAC RIVER ESTUARY

BOD_5 CONTRIBUTIONS 1966

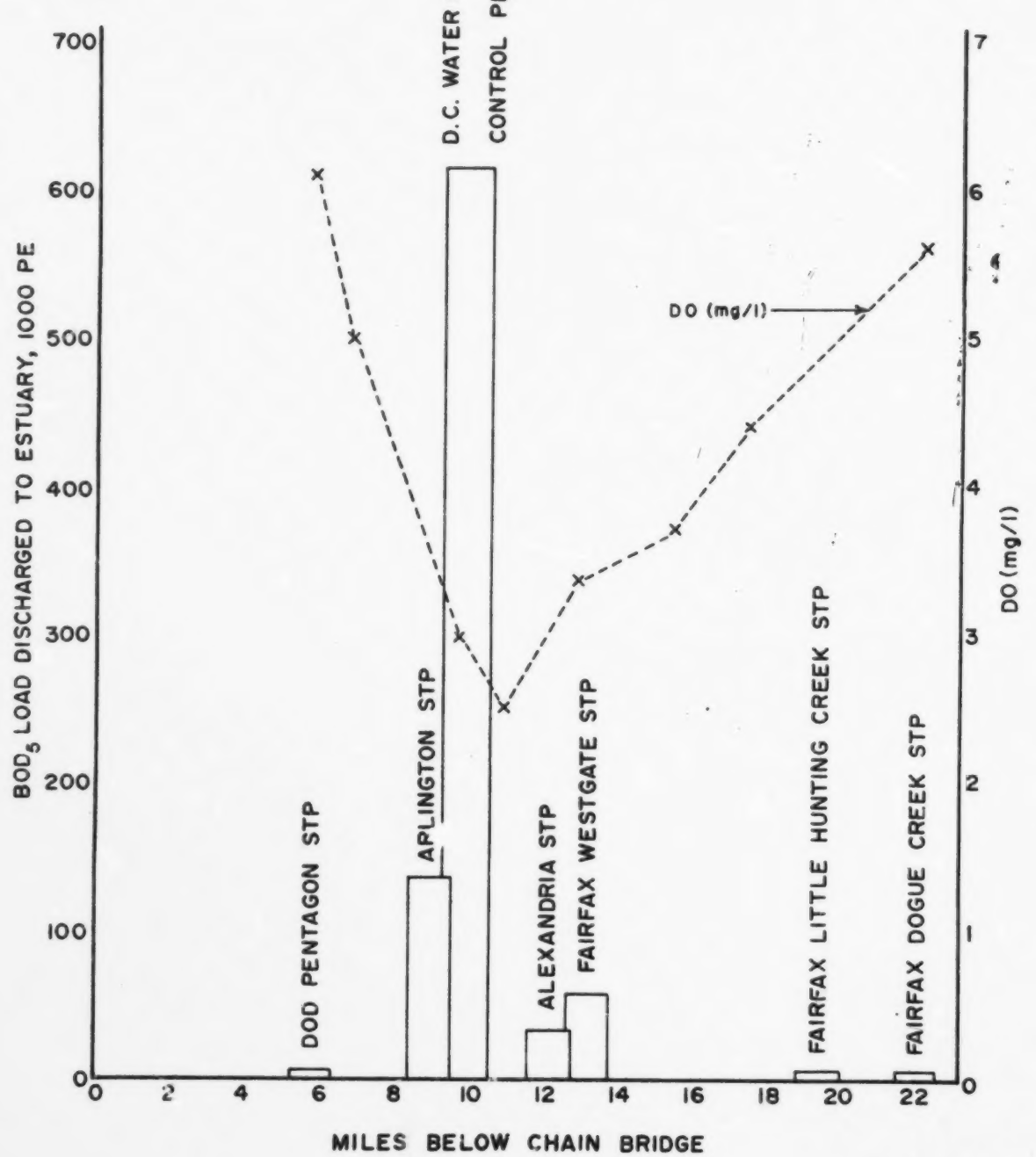
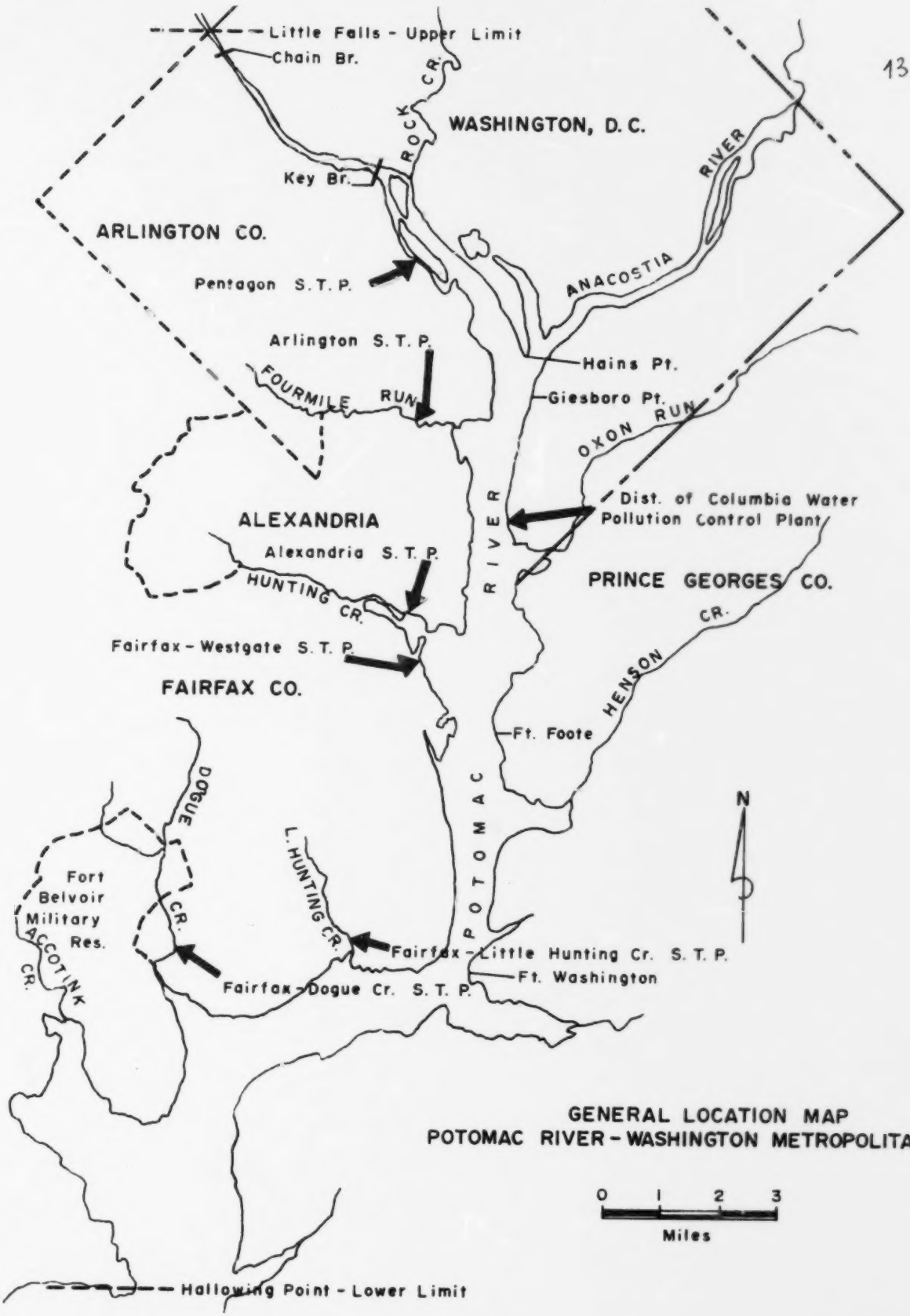


FIGURE 1



GENERAL LOCATION MAP
POTOMAC RIVER - WASHINGTON METROPOLITAN AREA

FIGURE 2